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THE NET ECONOMIC IMPACT OF LARGE FIRM OPENINGS AND CLOSURES IN THE STATE OF GEORGIA

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I. Introduction

In an effort to create jobs, spur income growth, and enhance the economic opportunities of its citizens more generally, state and local governments often offer newly locating or expanding business enterprises substantial financial incentives. In the State of Georgia, these incentives usually come in the form of broad tax concessions (such as those in the *BEST* legislation, sales tax exemptions, and enterprise zones) or financial incentive packages targeted to specific firms.¹

Recognizing the necessity of budget frugality, the State often commissions economic impact studies to evaluate the likely effects of these plant locations or expansions. While these studies do a reasonably good job of predicting the *gross* economic impact of a single firm location or expansion decision, they tend to neglect the simultaneity that exists between a single firm's location decision and the broader set of *all* firm start-up, relocation, expansion, and contraction decisions. This means that they may do a relatively poor job of estimating the *net* impact of firm location decisions, although it is this net impact that is of most concern to the State. Some recent national studies of very large firm openings suggest, in fact, that large firm openings often generate very little in the way of spillover employment, or multiplier effects, and in some cases may even have a negative effect on net.² Little research to date has examined the net effects of firm closures or the effects of firm openings while controlling for closures or expansions of existing firms.

The State of Georgia strives to create an attractive business environment in a fiscally responsible manner. This means economic development decisions must be made with full information. This report explores the net impact on job growth from large business openings or closures in the State of Georgia by empirically estimating the effects of these events on total county employment. We find that large firm location decisions generally have very minor spillover effects. Empirical results suggest that the average large (300+ employees) firm opening adds an additional 91 workers to total county employment per year, while the average large firm closure does not tend to reduce county-wide employment beyond the initial year of closing. An exception is high-technology firms, which tend to generate an additional 194 – 422 workers, depending on how high technology is defined. High-tech closures do

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not appear to result in statistically significant job losses beyond the initial closing year, but non-high-tech firm closures are estimated to generate between 20 and 30 annual additional job losses per year on average.

In terms of spillover impacts, for the average firm the spillover effect is estimated to be quite small: one spillover job is generated in the county for every 10 newly hired workers in a large firm location. Again, high-technology firms are a substantial exception. Depending on how high technology is defined 1 – 2 spillover jobs are generated in the county for every 3 workers employed in a new high-tech firm. By contrast, 11 workers must be hired by newly locating non-high-tech firms in order to generate a single spillover job in the county.

The remainder of the report proceeds as follows. In Section II we discuss the theoretical concepts that underlie the analysis. That is, we set out to explain why one firm's location decisions might have positive or negative spillover effects on existing firms or other potential entrants. In Section III we discuss the empirical methodology and the associated data, followed by a detailed analysis of the results in Section IV. The report ends with a brief conclusion and policy recommendations in Section V.

II. Conceptual Underpinnings

On the surface, one might think that the location of a large firm would spur local economic growth, all else equal. Likewise, the closure of a large firm would be expected to retard economic growth. That is, we might expect the county of location (closure) to register significantly greater (smaller) gains in terms of employment and personal income than would have been the case if the firm had chosen not to open (close) there. The direct effect would certainly suggest this to be the case. In reality, however, it is the indirect effects of large firm openings or closures that tend to carry the greatest weight in the total, or net, economic impact. These indirect impacts can be both positive and negative.

Because enterprises often generate additional income and employment from suppliers and through the consumption spending of their employees, and because there are tendencies for similar firms (within some industries) to aggregate in a single location, employment and income generation from one firm often yields multiplicative gains. However, large firm openings or closures also have opposing spillover effects that are likely to retard the growth of the local economy.

(Direct) Multiplier Effects

Supply Linkages

Perhaps the greatest potential for spillover benefits with a large plant location is the inducement of upstream firms, or suppliers, to migrate to the same location. If the newly locating (downstream) enterprise does not require enough of an intermediate input to cost-effectively produce it in-house, transportation costs are sufficiently high (because of size or fragility, for example), and/or the product must be delivered quickly at irregular intervals, then downstream firms are likely to cluster around a common input supplier, or alternatively, input suppliers may cluster around a common downstream firm. This additional employment and income generated indirectly from suppliers potentially can meet or exceed the levels generated directly by a newly locating enterprise.

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The location of the new BMW assembly plant in the Greenville-Spartanburg, SC area in 1993 provides a remarkable illustration of the importance of supply linkages in generating employment and income. Thirty-six of BMW's suppliers are located in South Carolina, all within a one-hour drive of the assembly plant. These suppliers employ approximately 4,700 workers and have invested over \$1 billion into their South Carolina operations. Perhaps most importantly, twenty-six of these suppliers chose to locate North American operations in South Carolina specifically to partner with BMW. By contrast, the direct effect of BMW's location in Greenville-Spartanburg was to employ 3,000 workers and invest \$1.4 billion in a 2.3 million square-foot facility.³

In the case of large plant closures, reduced demand for inputs is likely to compel a contraction of productive activity in upstream firms, possibly to zero. Thus, supply linkages, while beneficial when a new firm opens or an existing firm expands, may also exacerbate reductions in employment and income when faced with a substantial firm closure.

Generation of Consumer Spending

Any personal income arising from one firm's activity generates additional multiplier effects through subsequent rounds of consumer spending. That is, when employees spend their income on consumer goods and services, presumably a significant portion of that spending will be in the locale of their employment. This spending in turn generates additional employment and income, which is then respent, and so on. Although account would have to be taken for commuters, especially in relatively small jurisdictions, the multiplicative impact on employment and income arising from consumer spending can be expected to be quite substantial in most cases.

Expansion

Of course, the location of a large facility often portends of expansion in the future, as was the case for Saturn's Spring Hill, TN plant, Nissan's Smyrna, TN plant,

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and more recently, BMW's facility in Greenville-Spartanburg, SC.^a Saturn's initial (1985) Spring Hill employment was 3,000, but they subsequently added 6,000 additional workers.⁴ Likewise, the Smyrna, TN Nissan plant has expanded twice, first doubling its initial (1980) employment from 3,000 to 6,000, and then siting an additional (though considerably smaller) facility in nearby Drechard, TN in 1998.⁵ The Drechard facility currently employs 500 people. Finally, BMW recently announced plans to add 500 additional employees to its current workforce of 3,000 in South Carolina.⁶

The Clustering of Multiple Enterprises in a Single Location⁷

It is well-known that in many industries, larger firms can produce commodities at lower per-unit cost than can small firms. That is, the per-unit cost of production in *a single firm* declines as that *individual firm's* capacity and level of production increases. The presence of these *internal* economies of scale, which usually arise because of very large fixed costs (*e.g.*, plant and equipment), explains the domination of large firms in many manufacturing industries, such as transportation, aerospace, and defense, as well as some non-manufacturing industries like telecommunications and public utilities.

What is relatively less understood is that in some industries, per-unit production costs tend to decline when output in *the industry as a whole* increases, even if that output comes from *other firms*. Generally these *external* economies of scale are quite localized, especially in high-technology industries. From an economic development perspective, the crucial importance of localized external scale economies is that the situs of a single firm may yield substantial spillover benefits by increasing the attractiveness of that location to other firms within the industry. One only has to look to the Silicon Valley in California, the Route 128 technology corridor in Massachusetts, the Research Triangle in Raleigh-Durham, North Carolina, Hollywood, California, or our own Dalton, Georgia (Box 1) for evidence of the

^a The focus on automobile manufacturing facilities is not intended to suggest that this industry has greater or smaller advantages than other industries. Rather, the location of automobile manufacturing plants tends to generate a large amount of press and interest, and hence there generally is more detailed information available.

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Box 1

Agglomeration Economies and Economic Prosperity in Georgia: The Case of Dalton's Carpet Industry

Georgia's Carpet Industry: Extraordinary Growth From Humble Beginnings

In 1895, a teenaged girl named Catherine Evans Whitener made a bedspread for a wedding gift. This bedspread was not an ordinary bedspread, however. In an attempt to recreate a hand-crafted pattern she had seen, Catherine employed a craft that had long fallen out of use known as tufting, or candlewicking (this entails sewing thick cotton yarns with a running stitch into unbleached muslin, clipping the ends of the yarn so that they fluff out, and finally shrinking the fabric by washing it in hot water). As a result of this special wedding gift, the course of Dalton's economic future was changed forever.

Needless to say, the gift was well-received, and the quality of Catherine's handiwork quickly became legendary. The demand for her bedspreads increased tremendously, and she (and others) soon began selling them. Catherine sold her first bedspread in 1900 at a price of \$2.50, but by the 1930s, over 10,000 other "turfs" were producing tufted bedspreads in the Dalton area, still by hand. To keep up with exponentially increasing demand, the Glen Looper Foundry of Dalton developed the first mechanized tufting machine during the late 1930s, and by 1941, ninety-nine percent of all tufted bedspreads were machine-produced. The real boom in Dalton's tufting industry came after World War II, however, when it was discovered that formerly woven carpets could be made much more cheaply by tufting. Of course, in looking for experienced turfs, manufacturers naturally looked to Dalton, Georgia. The growth spawned by the carpet industry was enormous. In the four-year period immediately following the war, annual cotton consumption by Dalton's textile industry grew from 30,000 bales to 500,000 bales, more than 1,500 percent. Today over 90 percent of all carpets produced world-wide are tufted, up from 10 percent in 1950.

Agglomeration Benefits

Of course, as the number of tufted products produced annually went into the millions, the job of supplying the industry became equally important. Yarn, sheeting, duck mills, and agents were established in the area, with their entire output going to the industry; and larger mills elsewhere vied for the growing business. Machine shops were established to manufacture the thousands of single and multi-needle machines needed, as well as to design improvements aimed at making even more beautiful and better spreads, bathroom sets, robes, beach wear, and rugs. Dye plants for yarn were built. Laundries were erected for finishing the spreads. Printing shops were established to supply the millions of tags and labels needed. Box factories turned out cartons for shipping. Moving these spreads to market was big volume for rail and motor freight lines. Finally, machinery was developed for making chenille rugs and was widened, creating larger rugs and broadloom carpet. At the same time machinery was changing, developments of new fibers accelerated the growth of broadloom carpet.

Dalton's Carpet Industry and the Georgia Economy

Today Georgia's carpet manufacturers are responsible for 74 percent of total U.S. carpet production, and 44 percent of world carpet production. Moreover, Eighty percent of the U.S. carpet market is supplied by mills located within a 65-mile radius of Dalton, including Whitfield, Gordon, Catoosa, Murray, and Bartow counties. Georgia's 174 carpet manufacturing plants employ over 50,000 people and indirectly provide for over 30,000 additional employees *via* their suppliers. Finally, over 75 percent of the yarn used by the carpet industry is produced in Georgia.

Sources: Carpet and Rug Institute of America, "History of the Carpet Industry in the United States," 1998; Georgia's High Country Travel Association, "Mother of the Carpet Capital," accessed October 12, 2000 at <http://www.georgiahighcountry.org/legends02.html>; Paul Krugman, *Geography and Trade*, Cambridge, MA, MIT Press, 1991.

Note: Parts of the above were excerpted, with permission, from the Carpet and Rug Institute of America.

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strength of these forces for intra-industry agglomeration. At a more basic level, the mere existence of cities can be attributed in part to agglomeration economies. While there are innumerable benefits to industry clustering, the consensus is that these benefits come largely from labor pooling and technological spillovers.⁸

Labor Pooling

One of the great advantages of industry agglomeration is the potential for sharing workers. This proclivity for labor pooling is indeed one of the strongest forces for agglomeration in the computer industries of the Silicon Valley and Route 128. As a simple but illustrative example, consider two firms, each of which can produce in either of two locations, or alternatively, both may produce in the same location.⁹ Suppose further that the demands for workers in the two firms are uncertain and are not perfectly correlated (*e.g.*, the demand for one's product may increase while the other's decreases). Given the uncertainty of labor demand, workers will have an interest in locating where there are many firms that require their skills so that if they get laid off, another firm will be available to hire them. Likewise, given the uncertainty of labor demand, firms will want a large pool of specialized workers from which to hire so that they make take advantage of cyclically high demand for their product.

Now consider the case of 200 workers, and suppose that firms would like to hire 125 workers in "good times" and 75 workers in leaner periods. If the two firms locate in separate "company towns," they will be unable to take advantage of high demand that may periodically arise because they will only be able to hire 100 workers. As long as the firms' labor demands are not perfectly correlated, the firms are better off locating in the same place so that they may share a common pool of workers. Likewise, in lean times 25 workers would be unable to find employment utilizing their specialized skills in a company town, but if the two firms are similarly located, and again their labor demands are not perfectly correlated, workers would be able to find employment in the other high-demand firm. If at least some of the time one firm's good times coincide with another's bad times, both firms and workers benefit from the labor pooling made possible by intra-industry agglomeration.

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Technological and Knowledge Spillovers

Another argument made for the intra- and inter-industry agglomeration is that locational proximity speeds the transfer of knowledge. Intellectual spillovers are often cited, for example, in explaining the development of high-technology clusters such as the Silicon Valley, Route 128, and Research Triangle Park. Perhaps the greatest evidence of this force is the presence of prominent universities in these settings: Stanford University in the Silicon Valley, the Massachusetts Institute of Technology in the Route 128, and Duke University, the University of North Carolina, and North Carolina State University in the Research Triangle of North Carolina. High-technology firms benefit from the on-going, more basic research in these universities and are able to rapidly implement and market new technologies, often by working directly with academics or funding some of the research. Likewise, in working together, research and development teams from different firms often are able to access a mutual knowledge database and share intellectual resources.

Other Potential Forces for Agglomeration

Of course there are many other forces for agglomeration beyond labor pooling and intellectual spillovers, not the least of which is the more fundamental benefit of purchasing inputs from common suppliers. Moreover, even entirely different industries benefit from the physical and economic infrastructure that is made available by the presence of numerous substantial business firms. This infrastructure is not limited to roads, highways, and schools, but also includes the presence of well-developed financial institutions and supporting service firms – many of which are profitable only in locations where they can tap into a large number of firms. Finally, the role of perceptions cannot be underestimated in business location decisions. Although many start-up computer firms might be able to produce at much lower cost outside of the Silicon Valley, that location is understood to be the Eden of the industry, and perhaps more importantly, to be friendly to computer firms and to computer people. Likewise, South Carolina's aggressive use of tax abatements and other financial inducements has given it a reputation as a "business-friendly" environment, whether or not the reputation is warranted or the incentives are justified.

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Forces for Dispersion: Crowding-Out Potential Prospects

Of course, large firm locations may generate substantial negative spillovers, and likewise the economic effects of a large firm closure may be mitigated by positive spillovers. In the case of a large plant opening, subsequent increases in input costs like wages, reductions in input supplies, or even the perception that this might be occurring may deter other potential entrants from locating in the same jurisdiction. Moreover, new or expanded firms generally will further congest public services and infrastructure. This congestion is aggravated if the newly locating firm has been provided incentives, such as property tax abatements. The congestion of public services and infrastructure will generate additional costs to the government sector, with little in the way of additional financial resources. The local government then may be forced to raise tax rates, diminishing the attractiveness of the community to other potential investment. Likewise, in the case of a large plant closure, wage depression, more freely available input supplies, and an easing of infrastructure congestion may make the location more attractive for potential entrants and thus mitigate the direct impact.

Forces for Agglomeration and Dispersion Across Industries

One of the objectives of the empirical analysis that follows is to gauge not only the degree to which new firm openings or closures attract or repel other firms, but also to determine which types of firm openings or closures have the greatest spillover impact on the local economy. Much of the economic development emphasis in the last several years has been focused on attracting (or retaining) high-technology firms. Also, as in the past, manufacturing enterprises often are heavily recruited because of their relatively attractive pay structure. In terms of the forces for agglomeration and dispersion discussed above, we can begin to make some educated guesses as to the dominant forces for different types of industries and firms.

First, for manufacturing enterprises, specifically relatively low-tech cut-and-sew operations, low production cost tends to be the major factor in business location decisions, as evidenced by deconcentration in durable goods manufacturing and the shift of production from the northeast and Midwest to the

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relatively low-wage, right-to-work South or overseas to southeast Asia and Latin America. This suggests that dispersion forces may be relatively more important in these types of industries. The increase in input costs and congestion costs that generally arise with a large firm location might be expected to repel low-tech manufacturing enterprises.

For high-technology firms, on the other hand, innovation, speed, and flexibility tend to be the major location factor and input cost seems to be less important, which means that agglomeration forces are likely to be relatively strong within high-technology industries.¹⁰ Most of the cases presented in Section 2.2, in fact, were high-technology concentrated areas like Route 128, Silicon Valley, and Research Triangle Park. Despite the unusually high average wages in these communities, high-technology firms continue to flock there, as the agglomeration benefits presumably far outweigh the repellant forces of high labor costs and congestion costs.¹¹

Finally, proximity to customers tends to be crucial in the services, trade, and construction industries. In this sense we might expect the expansion of local consumer markets that arises with large firm locations, as well as the destruction of these markets with large firm closures, to drive service- and retail-based industries to high density areas. In the retail industry, the benefits of comparison shopping are likely to result in high degrees of intra-industry agglomeration as well.¹² Of course, the mining industry tends to be highly source-based given immobility and high transport costs, and thus we would expect minimal spillovers from these firms at best.

III. Data and Methodology

Empirical Methodology

An Empirical Model of County Employment

We begin with a parsimonious model of county employment given by

$$[1] \quad E_{i,t} = \alpha + \beta E_{i,t-1} + \gamma' X + \varepsilon_{i,t}$$

where $E_{i,t}$ is employment in county i at time t and $X_{i,t}$ is a vector of other variables influencing employment in county i at time t . The term $\varepsilon_{i,t}$ is a random disturbance or shock affecting county employment in county i at time t , where $\varepsilon_{i,t} = \mu_i + v_{i,t}$, $\mu_i \sim NIID(0, \sigma_\mu^2)$ is a county-specific, time-invariant error component, and the remainder of the disturbance is given by $v_{i,t} \sim NIID(0, \sigma_v^2)$.

Estimation of [1] presents a serious obstacle in that dynamic error component models are asymptotically biased by construction. That is, because $E_{i,t}$ is correlated with μ_i , and μ_i is time-invariant, lagged employment ($E_{i,t-1}$) must also be correlated with μ_i . We thus first-difference [1] to sweep out the μ_i :

$$[2] \quad E_{i,t} - E_{i,t-1} = \alpha + \beta(E_{i,t-1} - E_{i,t-2}) + \gamma'(X_{i,t} - X_{i,t-1}) + v_{i,t} - v_{i,t-1},$$

which can be written as

$$[3] \quad \Delta E_{i,t} = \alpha + \beta \Delta E_{i,t-1} + \gamma \Delta X_{i,t} + \Delta v_{i,t},$$

and then use $E_{i,t-2}$ as an instrument for $\Delta E_{i,t-1}$.¹³ Adding a vector of variables representing new firm openings and closings ($\theta_{i,t}$), we have the basic estimating equation:

$$[4] \quad \Delta E_{i,t} = \alpha + \beta E_{i,t-2} + \gamma \Delta X_{i,t} + \delta' \theta_{i,t} \Delta v_{i,t}.$$

Empirical Representation of Firm Openings and Closures

The components of the vector $\theta_{i,t}$ vary across specification, depending on the effects we are trying to identify. In the first class of models we estimate, $\theta_{i,t}$ consists of count variables representing firm openings ($CntOpen_{i,t}$) or closings ($CntClose_{i,t}$).

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To construct these count variables, we first define a dummy variable for each new firm j ($DVOpen_{j,i,t}$) or closing firm k ($DVClose_{k,i,t}$) such that

$$[5] \quad DVOpen_{j,i,t} = \begin{cases} 1 & \text{if firm } j \text{ is open in } i \text{ at time } t \\ 0 & \text{otherwise} \end{cases}$$

$$[6] \quad DVClose_{k,i,t} = \begin{cases} 1 & \text{if firm } k \text{ closed in } i \text{ at time } t^* < t \\ 0 & \text{otherwise} \end{cases}$$

and then calculate

$$[7] \quad CntOpen_{i,t} = \sum_j DVOpen_{j,i,t}$$

$$[8] \quad CntClose_{i,t} = \sum_k DVClose_{k,i,t}$$

Similar variables are constructed to differentiate high-technology or industry-specific firm openings and closures [$CntOpen_{i,t}(\text{type})$ and $CntClose(\text{type})$, respectively].

In the second class of models, which we term *multiplier models*, the vector $\theta_{i,t}$ contains measures of employment for firm openings. Two such measures are included, one for initial new firm employment ($INFE_{i,t}$) and one for continuous new firm employment ($NFE_{i,t}$), which are calculated as follows:

$$[9] \quad Emp_{j,i,t} = \begin{cases} \text{total firm } j \text{ employment} & \text{if } t \geq t^* \text{ and } j \text{ in } i \\ 0 & \text{otherwise} \end{cases}$$

$$[10] \quad InitEmp_{j,i,t} = \begin{cases} \text{total firm } j \text{ employment} & \text{if } t = t^* \text{ and } j \text{ in } i \\ 0 & \text{otherwise} \end{cases}$$

$$[11] \quad NFE_{i,t} = \sum_j Emp_{j,i,t}$$

$$[12] \quad INFE_{i,t} = \sum_j InitEmp_{j,i,t}$$

Again, similar variables are constructed to differentiate high-technology or industry-specific firm openings [$NFE_{i,t}(\text{type})$ and $INFE_{i,t}(\text{type})$, respectively]. In the multiplier models we continue to use count variables to represent firm closures.

Because $\theta_{i,t}$ includes separate variables to account for initial new firm employment, the coefficients on $NFE_{i,t}$ measure the spillover effects of new firm

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locations. After accounting for other influences on county employment, we can write employment in county i at time t as:

$$[13] \quad E_{i,t} = E_{i,t-1} + \sigma_1^{\Delta} INFE + \sigma_2^{\Delta} NFE.$$

In the firm's initial year (t^*), the change in county employment (from the previous year) will then be given by $(\sigma_1^{\Delta} + \sigma_2^{\Delta}) INFE_{i,t^*} = (\sigma_1^{\Delta} + \sigma_2^{\Delta}) NFE_{i,t^*}$, where (\wedge) represents an estimated parameter value. In each succeeding year ($t > t^*$), the change in county employment generated by the new firm will be given by $\sigma_2^{\Delta} NFE_{i,t}$ (recall $INFE_{i,t > t^*} = 0$), which is simply the spillover effect.

Data

The primary data source for the empirical analysis is the ES-202 firm-level employment data collected by the Georgia Department of Labor and maintained by the Fiscal Research Program's *Georgia Data Project*. The data is compiled from quarterly tax and wage information submitted to the Department of Labor by every employer covered by Georgia unemployment insurance. From the raw data we are able to calculate and record the employment of individual firms on quarterly basis, which we then annualized for the purpose of this analysis.

Utilizing the wealth of information that is available from these unemployment insurance records, we are able to identify the opening of new facilities and the closure of pre-existing facilities by noting their appearance or disappearance from the data. We are also able to identify the county in which each new facility is located.

Unfortunately, the time period for this analysis was characterized by substantial deregulation in some industries, which in turn lead to a large degree of merger and acquisition activity and reorganization. Especially affected were the communications (SIC 48), banking (SIC 60-61), and insurance (SIC 63-64) industries. While in other industries, we were able to identify mergers, acquisitions, and reorganizations with a reasonable degree of accuracy, attempts to identify such activity in these specific industries was judged to be too imprecise for use in the current study. Similar problems arose in the retail (SIC 52-59) and employment services (SIC 73) sectors, due again in part to mergers, acquisitions, and

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reorganizations, but also to substantial employment volatility and inconsistent reporting.

The problem with excluding these industries, as is done in this study, is the potential for data contamination bias. That is, to the extent that unidentified firm openings (closures) cause growth spurts (retardations) in the affected counties, the empirical estimate of the net impact of firm openings and closures on county growth patterns will be biased downward in magnitude (toward zero). Of course, improperly identifying an existing firm as a new firm would present exactly the same problem -- the estimated net impact of new firm openings (closures) would be biased downward. By excluding these specific industries, we contaminate the data no worse than would have been the case had we chosen to include them, given the guesswork and arbitrariness that would have been involved, and at the same time we are able to make some account by including changes in industry employment shares in the empirical analysis. Of course, if the number of new firm openings and closures (and the associated employment impacts) are similar, and there is little reason *a priori* to expect this not to be the case, any resulting bias will be minimized.^b

In addition to excluding certain industries from the analysis, 13 of Georgia's 159 counties were excluded as well. Our effort to engender a non-metro focus in the report necessitated an exclusion of the 10-county metropolitan Atlanta region for several reasons.^c First the use of a relatively low employment threshold (300) was required to provide a meaningful analysis for non-metro-Atlanta counties, given their relatively low populations and employment levels. Given the considerable number of plant openings and closures in metropolitan Atlanta where 300 or more employees were affected, any analysis of these counties would have been empirically meaningless. Secondly, and perhaps more importantly, is the closely related issue of Atlanta's substantial contribution to total economic activity in the state. Had we

^b That is, counties with unidentified openings will "over perform," while counties with unidentified closures will "under perform."

^c These counties correspond to the Georgia Department of Labor's Service Delivery Area 3 and include Cherokee, Clayton, Cobb, Dekalb, Douglas, Fayette, Fulton, Gwinnett, Henry, and Rockdale.

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included these 10 counties, metro Atlanta would have driven the results, and the analysis would effectively have been a metro Atlanta study.

The remaining three counties, Floyd, Gordon, and Whitfield were excluded for more practical reasons: the large number of textile manufacturing firms flagged as potential openings or closings proved to be an insurmountable obstacle for reasonably precise identification. Given the dominance of textile manufacturing in these counties, it was decided in the interest of data integrity to exclude the counties altogether rather than simply to exclude textile firms.

Our investigation of the ES-202 data indicated that there were 94 firm openings in Georgia over the 1985-1998 period that employed 300 or more people within two years of opening. The largest new firm in the data over this time period opened with 2,216 initial employees. The largest employer among 98 closed firms retained 1,747 workers in the final year of operation. Muscogee County enjoyed the most new large firm locations over this period at 6, while Bibb County lead the state with the most large firm closures at 7.

In addition to calculating total firms openings and closings and their associated employment levels, we also identified the firms by industry in an effort to determine which industries or types of firms saw the greatest net employment impacts.^d Our primary effort was to differentiate high-technology firms from non-high-tech firms. To accomplish this task we had to first define high technology in terms of the Standard Industrial Classification (SIC). While several groups have defined what it means to be a high-technology firm, we chose to narrow our classification to three, which we term the *American Electronics Association (AEA) definition*,¹⁴ which is our narrowest grouping; the *Fiscal Research Program's (FRP) high-intensity technology definition*,¹⁵ which is an intermediate grouping in terms of exclusivity; and finally our *broadest definition*, which includes all firms covered in

^d For confidentiality reasons, we are able to report industries only by SIC 1-digit classification or by their distinction as high-tech or non-high-tech industries. Although the high-tech distinction is an important factor in the empirical analysis presented below, an analysis based on SIC classification did not yield useful results because of the limited number of firms in each industry category. Thus the empirical results are not reported by SIC classification.

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the FRP high-intensity technology definition plus firms that fall under the FRP's medium-intensity technology definition.¹⁶ Table 1 provides the SIC 4-digit codes that fall under each classification.

The primary control variables used in the analysis include (2-period) lagged total county employment ($E_{i,t-2}$), employment growth for the State of Georgia as a whole (ΔE_t^{State}), changes in manufacturing's share of total employment in the county ($\Delta Share_{i,t}^{man}$), and as a proxy for wages, the change in per capita net earnings lagged one period ($\Delta W_{i,t-1}$). Variable descriptions and sample statistics are presented in Table 2.

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TABLE 1. HIGH TECHNOLOGY INDUSTRY DEFINITIONS

American Electronics Association, high technology industries

3571 3572 3575 3577 3578 3579 3651 3652 3661 3663 3669 3671 3672 3675 3676 3677 3678 3679 3821
3822 3823 3824 3825 3826 3829 3827 3861 3821 3844 3845 4812 4813 4822 4841 4899 7371 7372 7373
7374 7375 7376 7377 7378 7379

Fiscal Research Program, high-intensity technology industries

2833 2834 2835 2836 3571 3572 3575 3577 3578 3579 3612 3613 3651 3652 3661 3663 3669 3671 3672
3674 3675 3676 3677 3678 3679 3721 3724 3728 3761 3764 3769 3812 3821 3822 3823 3824 3825 3826
3827 3829 3841 3842 3843 3844 3845 3861 4812 4813 4822 4841 4899 7371 7372 7373 7374 7375 7376
7377 7378 7379 8711 8712 8713 8731 8732 8733 8734

Broadest definition, high technology industries

0182 1311 2812 2813 2816 2819 2821 2822 2823 2824 2833 2834 2835 2836 2841 2842 2843 2844 2851
2861 2865 2869 2873 2874 2875 2879 2891 2892 2893 2895 2899 2911 3351 3353 3354 3355 3356 3357
3482 3483 3484 3489 3511 3519 3531 3532 3533 3534 3535 3536 3537 3541 3542 3543 3544 3545 3546
3547 3548 3549 3552 3553 3554 3555 3556 3559 3561 3562 3563 3564 3565 3566 3567 3568 3569 3571
3572 3575 3577 3578 3579 3612 3613 3621 3624 3625 3629 3643 3651 3652 3661 3663 3669 3671 3672
3674 3675 3676 3677 3678 3679 3711 3713 3714 3715 3716 3721 3724 3728 3761 3764 3769 3812 3821
3822 3823 3824 3825 3826 3827 3829 3841 3842 3843 3844 3845 3861 4812 4813 4822 4841 4899 7371
7372 7373 7374 7375 7376 7377 7378 7379 7812 7819 8062 8069 8092 8071 8711 8712 8713 8731 8732
8733 8734 8741 8742 8743 8744 8748 8999

TABLE 2. SAMPLE STATISTICS

Variable	Description	Mean (Std Deviation)	Minimum	Maximum
$\Delta E_{i,t}$	Dependent Variable -- Change in county i total employment at date t [Bureau of Economic Analysis]	248.6 (642.0)	- 4,141	4,894
$E_{i,t-2}$	Total Employment in county i at time t-2 [Bureau of Economic Analysis]	22,470.6 (32,934.0)	311	149,733
ΔE_t^{State}	Change in total Georgia employment at date t [Bureau of Economic Analysis]	90,272.6 (65,818.0)	- 43,127	172,005
$\Delta Share_{i,t}^{manf}$	Change in manufacturing's share of total employment in county i at date t [Fiscal Research Program, ES-202]	- 0.0040 (0.0260)	- 0.5038	0.2820
$\Delta W_{i,t-1}$	Change in per capita net earnings in county i at date t-1 [Bureau of Economic Analysis]	375.7 (391.7)	- 1,073	4,788

IV. Empirical Results

Intervention Models

Table 3 presents empirical results for five intervention models of county employment, where the key variables are count variables for newly opened or closed firms, as defined in equations [7] and [8]. The dependent variable in every case is the change in total employment in county i at time t ($\Delta E_{i,t}$). The intervention variables are $CntOpen_{i,t}$ and $CntClose_{i,t}$, which in models 1 and 2 apply to firm openings and closings of any type, while in models 3-5 the intervention variables differentiate high-technology firm openings and closings from non-high-technology openings and closings. From model 3 to model 5, the definition of “high technology” becomes more and more narrow. Model 5 defines high technology according to the standards of the American Electronics Association (high-tech; AEA), the model 4 definition of high technology corresponds to the Fiscal Research Program’s definition of high-intensity technology (high-tech; FRP), while the model 3 definition of high technology is inclusive, incorporating all firms that fall under the AEA and FRP definitions, as well as those defined by the Fiscal Research Program as *medium-intensity technology*.

Models 1 and 2 suggest that the average firm opening increases annual county employment growth by around 91 workers, and closings decrease growth by about 20 workers, although the latter is not statistically different from 0. The results from models 3-5 suggest that the type of firm that opens or closes matters a great deal, however. Newly locating high-technology firms generate significantly greater annual county employment growth than do new non-high-tech firms, even after controlling for initial employment levels. The average new high-tech firm increases annual county employment growth by 194 to 422 workers, depending on how high technology is defined. The more narrowly that high-technology is defined, the greater the overall employment impact of a new high-tech firm location. AEA high-tech firms generate 422.3 additional workers annually, on average, while the broader class of FRP high-tech firms generates about 194.4 on average. The broadest measure of high technology, which includes the FRP’s medium-intensity technology firms, generates 210.8 additional workers annually on average. By contrast, non-

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TABLE 3. EMPIRICAL RESULTS INTERVENTION MODELS

Variable	Model				
	1	2	3	4	5
Intercept	- 309.8*** (60.8)	- 307.0*** (60.7)	- 303.7*** (60.7)	- 302.6*** (60.7)	- 313.2*** (60.7)
E_{t-2}	0.018*** (0.0008)	0.017*** (0.0008)	0.017*** (0.0008)	0.017*** (0.0008)	0.018*** (0.0008)
ΔE_t^{State}	0.003*** (0.0002)	0.003*** (0.0002)	0.003*** (0.0002)	0.003*** (0.0002)	0.003*** (0.0002)
$\Delta Share_{i,t}^{manf}$	1,190.4*** (410.3)	1,162.4*** (408.9)	1,152.8*** (408.6)	1,153.3*** (408.8)	1,156.3*** (408.6)
$\Delta W_{i,t-1}$	0.142*** (0.031)	0.147*** (0.031)	0.148*** (0.031)	0.147*** (0.031)	0.145*** (0.031)
$CntOpen_{i,t}$	101.6*** (19.2)	90.5*** (19.9)			
$CntClose_{i,t}$	- 44.7*** (16.0)	- 23.4 (16.7)			
$INFE_{i,t}$		0.276** (0.102)	0.284*** (0.102)	0.280*** (0.102)	0.280*** (0.102)
$ICFE_{i,t}$		- 0.476*** (0.124)	- 0.469*** (0.124)	- 0.468*** (0.124)	- 0.473*** (0.124)
$CntOpen_{i,t}$ (high-tech; broad)			210.8*** (68.9)		
$CntOpen_{i,t}$ (high-tech; FRP)				194.4** (75.5)	
$CntOpen_{i,t}$ (high-tech; AEA)					422.3*** (162.4)
$CntOpen_{i,t}$ (non-high-tech)			76.1*** (21.0)	84.5*** (20.3)	86.6*** (20.0)
$CntClose_{i,t}$ (high-tech; broad)			- 91.5 (58.4)		
$CntClose_{i,t}$ (high-tech; FRP)				- 92.8 (65.4)	
$CntClose_{i,t}$ (high-tech; AEA)					---
$CntClose_{i,t}$ (non-high-tech)			- 14.3 (18.2)	- 18.8 (17.1)	- 21.7 (16.7)
Adjusted R ² (F-value)	0.41*** (104.2)	0.41*** (93.2)	0.42*** (83.3)	0.41*** (83.1)	0.42*** (88.1)

Notes:

Standard errors in parentheses; *** indicates significance at the 99 percent confidence level; ** indicates significance at the 95 percent confidence level; * indicates significance at the 90 percent confidence level. No high-tech firms under the AEA definition closed in Georgia during the time period considered.

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high-tech firms generate between 76 and 87 additional workers in the county annually, again depending on the definition of high technology.^e

Most of the control variables were highly significant determinants of county employment growth as well, and the coefficient estimates were remarkably robust across specification. Growth in county employment tends to follow state employment growth ($\Delta E_{i,t}^{State}$) and tends to be higher in larger counties (in terms of total employment, $E_{i,t-2}$) that have greater concentrations of manufacturing employment ($\Delta E_{i,t}^m$). The lagged change in wages, as measured by per capita net earnings, showed a surprisingly positive and statistically significant relationship with county employment growth.^f

Multiplier Models

Table 4 presents empirical results for four multiplier models of county employment. The key variables of interest in these analyses are those that represent new firm employment from the initial year and onward ($NFE_{i,t}$), from which the parameter estimates (σ_2^{Δ}) are used to estimate the employment spillovers. Model 1 does not differentiate firm openings by type, while models 2-4 isolate the effects of high-technology firms vis-à-vis other firms according to the broad definition of high-technology, the Fiscal Research Program definition of high-intensity technology and the American Electronics Association definition of high-technology, respectively.

In model 1, the coefficient estimate on $NFE_{i,t}$ is 0.10, which suggests that for every 10 workers employed by a newly established facility, roughly one additional job will be generated in the county outside of that firm. By comparison, the equivalent spillover employment impacts generated for the State

^e In model 5, for example, the non-high-tech group includes firms that would be considered to be high-tech under the FRP definition, which explains why both the high-tech and non-high-tech coefficients increase from model 3 to model 5.

^f The change in per capita net earnings was lagged (as an instrument) to account for potential endogeneity with county employment growth.

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TABLE 4. EMPIRICAL RESULTS MULTIPLIER MODELS /a/

Variable	Model			
	1	2	3	4
Intercept	- 334.3*** (61.1)	- 340.8*** (61.2)	- 342.5*** (61.3)	- 350.6*** (61.2)
E_{t-2}	0.017*** (0.0008)	0.017*** (0.0008)	0.017*** (0.0008)	0.017*** (0.0008)
ΔE_t^{State}	0.003*** (0.0002)	0.003*** (0.0002)	0.003*** (0.0002)	0.003*** (0.0002)
$\Delta Share_{i,t}^{manf}$	1,175.4*** (408.8)	1,160.6*** (409.7)	1,154.1*** (410.1)	1,152.2*** (409.8)
$\Delta W_{i,t-1}$	0.145*** (0.031)	0.143*** (0.031)	0.144*** (0.031)	0.142*** (0.031)
$NFE_{i,t}$ /b/	0.100*** (0.020)			
$INFE_{i,t}$	0.266*** (0.103)			
$CntClose_{i,t}$ /c/	- 13.0 (16.4)			
$ICFE_{i,t}$	- 0.470*** (0.124)			
$NFE_{i,t}$ (high-tech, broad definition)		0.311*** (0.091)		
$NFE_{i,t}$ (high-tech, FRP definition)			0.170* (0.103)	
$NFE_{i,t}$ (high-tech, AEA definition)				0.548** (0.219)
$INFE_{i,t}$ (high-tech, broad definition)		- 0.085 (0.474)		
$INFE_{i,t}$ (high-tech, FRP definition)			0.760 (0.517)	
$INFE_{i,t}$ (high-tech, AEA definition)				1.366 (1.201)
$NFE_{i,t}$ (non-high-tech)		0.082 (0.021)	0.094*** (0.017)	0.093*** (0.020)
$INFE_{i,t}$ (non-high-tech)		0.245** (0.105)	0.201* (0.104)	0.216** (0.103)
$CntClose_{i,t}$ (high-tech, broad definition)		- 104.2* (58.5)		
$CntClose_{i,t}$ (high-tech, broad definition)			- 96.3 (65.3)	
$CntClose_{i,t}$ /d/				----
$CntClose_{i,t}$ (high-tech, broad definition)				
$CntClose_{i,t}$ (non-high-tech)		- 24.4 (17.0)	- 28.9* (16.0)	- 21.1** (15.6)
Adjusted R ²	0.41***	0.41***	0.41***	0.41***
(F-value)	(93.4)	(82.2)	(81.8)	(87.0)

Notes:

/a/ Standard errors in parentheses; *** indicates significance at the 99 percent confidence level; ** indicates significance at the 95 percent confidence level; * indicates significance at the 90 percent confidence level.

/b/ The variable new firm employment includes the level of employment for newly opened firms (after 1985) for every county i and every date t .

/c/ The firm closings dummy variable takes a value of one from the year after the firm closing onward.

/d/ No high-tech firms under the AEA definition closed in Georgia during the time period considered.

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of Georgia by the popular IMPLAN input-output program, which does not consider negative spillovers and agglomeration economies, range from 0.47 (wholesale and retail trade) to 1.51 (manufacturing).^g The analysis suggests that much under-appreciated negative spillover effects may eradicate much of the positive spillovers arising from upstream production and induced consumption spending.

As in the intervention models, new high-technology firms generated considerably more spillover employment than did non-high-tech firm openings, and the spillovers were greater the more narrowly we defined high technology. While estimated spillover employment impacts for non-high-tech industries ranged from 0.08 to 0.09 (1 spillover worker generated for every 11 new firm employees), high-tech employment spillover impacts from 0.17 under the FRP high-intensity technology definition to as high as 0.55 under the AEA definition. Thus more than 5 spillover workers are expected to be generated for every 10 workers employed by a new AEA-defined high-tech firm. The estimated ratios of additional jobs to jobs in new establishments under the FRP high-intensity and broadest definitions of high-technology are approximately 1:6 and 1:3, respectively.

^g IMPLAN Professional V2.0, using 1996 input-output data for the State of Georgia aggregated at the SIC 1-digit level. These spillover impacts were generated by subtracting one (the direct employment effect) from the IMPLAN SAM multipliers, which were 1.47 and 2.51 for trade and manufacturing, respectively. Type-I multipliers range from 1.18 to 1.85. The SAM (Social Accounting Matrix) multipliers incorporate the direct effect of new job creation, all indirect effects, which is employment generated from suppliers within the same region, and induced effects from consumption spending, *etc.* The Type-SAM multiplier is given by (direct effects + indirect effects + induced effects) / direct effects; the Type-I multiplier excludes induced effects and is equal to (direct effects + indirect effects) / direct effects. If there are no indirect or induced effects, of course the Type-I and Type-SAM multipliers would both be unity.

V. Conclusions And Policy Recommendations

This report has argued that there are several counter-veiling forces for industry agglomeration and dispersion, and thus empirical analysis is needed to fully gauge the net economic impact of large firm openings and closures. We find that traditional input-output models probably overstate the net economic impact of large firm locations, as our spillover employment estimate is 0.10 for all firms, meaning that one spillover job is created for every 10 workers hired by a newly locating firm. Nevertheless, high-technology firms, which we argued should have greater spillover benefits from a conceptual standpoint, appear to have substantially larger employment multipliers empirically as well. While non-high-tech firms generate estimated employment spillover impacts of 0.08 – 0.09, on average, the analysis suggests that employment spillovers for high-technology firms would fall in the range of 0.17 to 0.55, depending on how high-technology is defined.

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Notes

¹ For recent studies of the effectiveness of Georgia's industrial incentive programs in attracting new firm locations and expansions, see Dagney Faulk, "An Analysis of the Employment Impact of Georgia's Job Tax Credit," *Fiscal Research Program Report No. 38*, December, 1999; Dagney Faulk, Keith R. Ihlanfeldt, David L. Sjoquist, William J. Smith, Jeanie Thomas, and Kathleen Thomas, "An Analysis of Georgia's Economic Development Tax Credit Incentives," *Fiscal Research Program Report No. 42*, January, 2000; and David L. Sjoquist, William J. Smith, and Kathleen Thomas, "A Profile of Georgia's Economic Performance and Competitiveness," *Fiscal Research Program Report No. 41*, January, 2000. For a review of incentive programs across the Southeast, see Jeanie Thomas, "State Economic Development Incentives in the Southeast," *Fiscal Research Program Report No. 40*, January, 2000.

² William F. Fox and Matthew N. Murray, "Incentives, Firm Location Decisions, and Regional Economic Performance," in Helen H. Ladd, *Local Government Tax and Land Use Policies: Understanding the Links* (Cheltenham, UK: Edward Elgar), 1998. See also by the same authors, "Do Economic Effects Justify the Use of Fiscal Incentives?" Working Paper, University of Tennessee, 2000.

³ "BMW Expands Spartanburg," *BMW Press Release*, BMW AG, Munich, June 28, 2000. The BMW plant, which is located off Interstate 85 between Greenville and Spartanburg, produces Z3 roadsters and X5 sports activity vehicles. For more on BMW's impact on the upstate South Carolina economy, see Douglas P. Woodward, "Assessing Economic Development Incentives: Lessons from BMW," *Proceedings of the Eighty-Sixth Annual Conference on Taxation*, National Tax Association, 1994; and South Carolina Department of Commerce, *BMW in South Carolina: Economic Benefits*, mimeo, November, 1994. For a decidedly different perspective on the effects of BMW's South Carolina plant, see Jurgen Brauer, "South Carolina Gets Nod for New BMW Plant -- But Nebraska May Have Won," *The Augusta Chronicle*, July 11, 1992.

⁴ William F. Fox and David T. Mayes, "Are Economic Development Incentives Too Large?" *Proceedings of the Eighty-Sixth Annual Conference on Taxation* (Washington, DC: National Tax Association).

⁵ Fox and Mayes, *op. cit.*; Nissan Motor Manufacturing Corporation USA

⁶ BMW AG, *op. cit.*

⁷ For a more detailed (and technical) discussion of agglomeration forces in economic activity, see Masahisa Fujita, Paul Krugman, and Anthony J. Venables, *The Spatial Economy: Cities, Regions, and International Trade* (Cambridge, MA: MIT Press), 1999; Arthur O'Sullivan, *Urban Economics* (Boston, MA: Irwin McGraw-Hill), 2000; Paul Krugman, *Geography and Trade* (Cambridge, MA: MIT Press), 1991; and Raymond Vernon, "External Economies," in M. Edel and J. Rothenberg (Eds.), *Readings in Urban Economics* (New York, NY: Macmillan), 1972.

⁸ Most of the formal economics literature, both theoretical and empirical, focuses on these sources of external scale economies. See Krugman, 1991, *op cit.* and Fujita *et al.*, *op cit.*

⁹ This illustration is taken directly from Krugman, 1991, *op cit.*, pp. 38-41.

¹⁰ See Robert D. Atkinson, Randolph H. Court, and Joseph M. Ward, *The State New Economy Index: Benchmarking Economic Transformation in the States* (Washington, DC: Progressive Policy Institute), 1999.

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¹¹ Although San Jose, Boston, and to some degree Austin, TX continue to be the high-tech meccas, the high-tech industry has been expanding beyond its traditional locations recently. From 1998-1999, Washington, Kansas, Colorado and Georgia all posted greater percentage gains in high-tech employment than did California. See American Electronics Association, *op cit.* and Jennifer Bjorhus, "Boom in Tech Jobs Expanding in U.S.," *San Jose Mercury News*, May 16, 2000.

¹² For a more detailed discussion of this issue, see B. Curtis Eaton and Richard G. Lipsey, "Comparison Shopping and the Clustering of Homogeneous Firms," *Journal of Regional Science*, 19 (pp. 421-435), 1979.

¹³ See T. W. Anderson and C. Hsiao, "Estimation of Dynamic Models with Error Components," *Journal of the American Statistical Association*, 76 (pp. 598-606) and Badi Baltagi, *Econometric Analysis of Panel Data* (West Sussex, UK: Wiley), 1995. Either $\Delta E_{i,t-2}$ or $E_{i,t-2}$ are valid instruments for $\Delta E_{i,t-1}$ in that they will be uncorrelated with $\Delta v_{i,t-1}$ as long as the $v_{i,t}$ are not serially correlated. Although parameter estimates are unbiased and consistent with both instruments, the use of the instrument in levels is an effort to enhance the efficiency of the estimates. See M. Arellano and S. Bond, "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations," *Review of Economic Studies*, 58 (pp. 277-297), 1991.

¹⁴ American Electronics Association, *Cyber States 4.0: A State-By-State Overview of the High-Technology Industry*, Washington, DC, 2000.

¹⁵ Susan Walcott, "Defining Technology in Georgia," *Fiscal Research Program Report*, forthcoming. All industries listed as high technology by the American Electronics Association (AEA) also fall under the Fiscal Research Program (FRP) high-intensity technology definition; thus, the AEA list is a subset of the FRP list.

¹⁶ *Ibid.*

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